



Big Spirit Lake in Dickinson County.

Marble, and Sandy) and one county beach (Orleans) are monitored weekly during the outdoor recreation season for bacteria and microcystin. Results of beach monitoring can be found on the DNR website <http://wqm.igsb.uiowa.edu/activities/beach/beach.htm>.

Volunteer Opportunities

IOWATER – Iowa's Volunteer Water Monitoring Program. Email: iowater@iowater.net
Website: <http://www.iowater.net>.

Anyone interested in becoming a CLAMP volunteer should contact Jane Shuttleworth, CLAMP Volunteer Coordinator: 712-337-3669 ext. 7.

References

Carlson, Robert E. (1977) A Trophic State Index for Lakes. *Limnology and Oceanography*, Vol. 22, No. 2 (Mar., 1977), p. 361-369.

Acknowledgements

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The CLAMP program would not be possible without the hard work of volunteers. Volunteers for Big Spirit Lake include: Sam Anderson, Don Brosnahan, Joyce Eubanks, Don Hill, Eric Hoien, Jim and Jesse Howard, Eldon Hovey, Ray and Marilyn Miller, Orlin Olson, Michele Petersen, Marv Rolf, Duane and Kim Rost, John Vaubel, Bea Zeigler, and Ike Zeigler. Thanks also to CLAMP interns: Tasida Barfoot, Ted Klein, Emily Greives, and Laura Guderyahn.

Photo on page 1 from CLAMP Program. Page 4 photo from Iowa State University Limnology Laboratory.

Iowa Watershed Monitoring and Assessment Program Web Site – wqm.igsb.uiowa.edu



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IOWA'S WATER

Ambient Monitoring Program

Cooperative Lakes Area Monitoring Project Big Spirit Lake

The Cooperative Lakes Area Monitoring Project (CLAMP) began in 1999 as a joint partnership between Iowa Lakeside Laboratory and Friends of Lakeside Laboratory to take advantage of a rich tradition of volunteer involvement in the Iowa Great Lakes region. CLAMP combines efforts of multiple organizations into a long-term, unified program for assessing the quality of the lakes in the region. A group of volunteers was organized and trained to monitor water quality on 10 lakes in northwest Iowa. CLAMP focuses on monitoring nutrient levels (nitrogen and phosphorus) as well as chlorophyll *a* (an index of algal abundance) and Secchi depth (an index of water clarity). By monitoring these parameters, CLAMP volunteers provide an integrated measure of each lake's water quality. To address concerns of excessive algae growth, phytoplankton and microcystin were recently added to the program. Phytoplankton are microscopic plants, mainly algae, that live in water. Microcystin is a toxin produced by cyanobacteria, a type of algae.



A CLAMP volunteer collects a water sample.

Since its inception in 1999, over 100 volunteers have participated in CLAMP. These volunteers have taken over 3500 samples on 10 lakes in Dickinson County: Big Spirit, Center, East Okoboji, Little Spirit, Lower Gar, Minnewashta, Silver, Trumbull, Upper Gar, and West Okoboji. By volunteering their time, CLAMP participants are providing a long-term data set that will be useful in protecting these prized resources while learning more about water quality issues and the ecology of the lakes.

CLAMP Data

Secchi depth in Big Spirit Lake ranged from 0.7 meters (m) on 8/25/2005 to 4.6 m on 6/8/2001, with the deepest Secchi depths occurring in spring, when algal productivity is the lowest, and the shallowest in late summer, when algal productivity is greatest. Overall, the median Secchi depth in Big Spirit

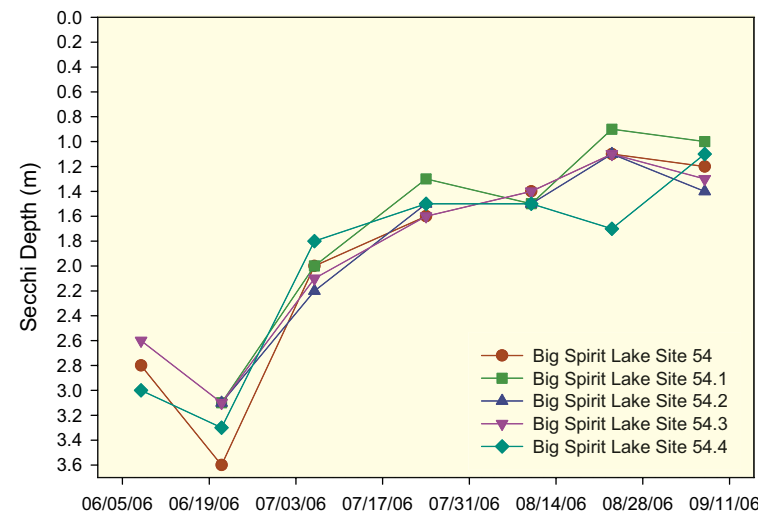
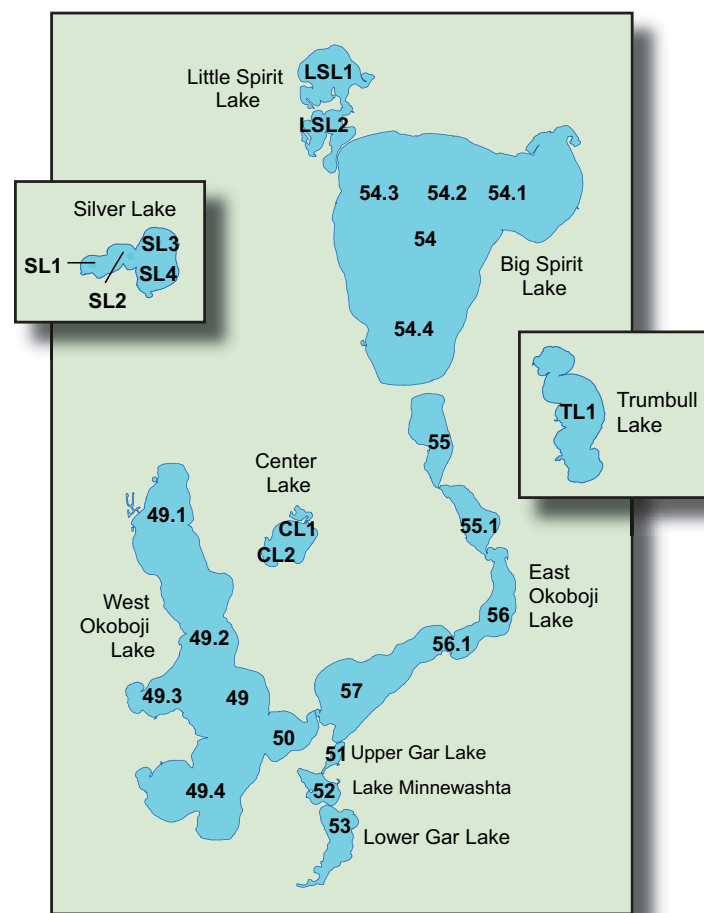


Figure 1. Seasonal and site variation of Secchi depth in 2006 for Big Spirit Lake.



CLAMP sampling locations. NOTE: data used for this fact sheet were from the deepest spot in each lake (for comparison).

was deeper than all other CLAMP lakes with the exception of West Okoboji and deeper than the median of other glacial lakes in Iowa (Insert 1).

Total phosphorus and total nitrogen concentrations were low in Big Spirit compared to other CLAMP lakes (Insert 1). With the exception of West Okoboji, Big Spirit had the lowest median total phosphorus (0.06 milligrams per liter [mg/L]) and total nitrogen (1.1 mg/L) as well as a lower median concentration than other glacial lakes in Iowa. Total phosphorus ranged from 0.025 mg/L to 0.171 mg/L. Total nitrogen ranged from 0.28 mg/L to 3.03 mg/L.

Chlorophyll *a* concentrations ranged from 2 µg/L (6/8/01) to 208 µg/L (8/22/04). The median chlorophyll *a* concentration was less than all other CLAMP lakes with the exception of West Okoboji and less than the median for other glacial lakes in Iowa (Insert 1).

Microcystin concentrations in Big Spirit ranged from 0.4 nanograms per liter (ng/L) to 7.5 ng/L. Big Spirit's maximum concentration of 7.5 ng/L falls below the 20 ng/L threshold the Iowa DNR uses to post warnings at swimming beaches. Overall, microcystin concentrations were slightly higher than other CLAMP lakes and slightly lower when compared to other glacial lakes in Iowa (Insert 1).

Figure 1 shows the seasonal and site variation of Secchi depth for Big Spirit Lake in 2006. Secchi depths were deepest in June and shallowest in the summer and early fall. There was little

difference between sites on Big Spirit Lake. Site 54 had the deepest Secchi depth (3.6 m on 6/21/2006). Site 54.1 generally had a slightly shallower Secchi depth than other sites.

Carlson's Trophic State Index

The large amount of water quality data collected by CLAMP can be confusing and difficult to evaluate. In order to analyze all of the data collected it is helpful to use a trophic state index (TSI). A TSI condenses large amounts of water quality data into a single, numerical index. Different values of the index are assigned to different concentrations or values of water quality parameters.

The most widely used and accepted TSI, called the Carlson TSI, was developed by Bob Carlson (1977). Carlson TSI values range from 0 to 100. Each increase of 10 TSI points (10, 20, 30, etc.) represents a doubling in algal biomass. The Carlson TSI is divided into four main lake productivity categories: *oligotrophic* (least productive), *mesotrophic* (moderately productive), *eutrophic* (very productive), and *hypereutrophic* (extremely productive). The productivity of a lake can therefore be assessed with ease using the TSI score for one or more parameters. Mesotrophic lakes, for example, generally have a good balance between water quality and algae/fish production. Eutrophic lakes have less desirable water quality and an overabundance of algae or fish. Hypereutrophic lakes have poor water quality and experience frequent algal blooms and a lack of oxygen in deep water.

Insert 2 shows the TSI scores for Secchi depth, chlorophyll *a*, and total phosphorus for all CLAMP lakes. The median TSI scores for Big Spirit Lake are in the *eutrophic* category for all parameters. TSI scores based on total phosphorus are generally higher than other TSI scores. This indicates that phosphorus is not limiting algae growth. Possible other factors that could limit algae include: light limitation due to excessive algal or non-algal turbidity, zooplankton grazing, nitrogen limitation, or toxin production.

Figure 2 shows the mean or average TSI scores for Big Spirit by year. TSI Scores have not varied greatly from 1999-2006. Overall the TSI scores were in the *eutrophic* category every year.

Other Monitoring

Iowa DNR - Ambient Lake Monitoring Program. Along with the volunteer monitoring that occurs through the CLAMP program, the lakes are routinely monitored throughout the summer by the

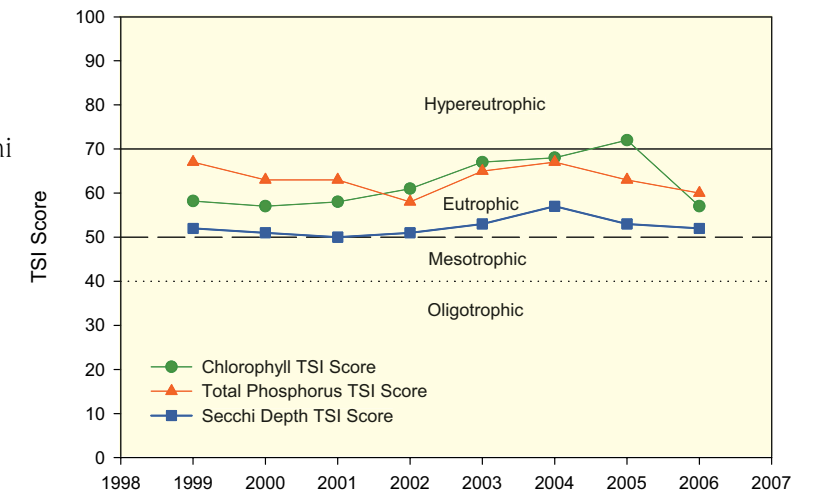


Figure 2. Average Carlson Trophic State Index (TSI) scores by year for Big Spirit Lake.